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Indian Standard

PROCEDURE FOR BASIC CLIMATIC AND DURABILITY TESTS FOR OPTICAL INSTRUMENTS

PART 12 SHOCK TEST

UDC 681·7 : 620·178·167

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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February 1986

Indian Standard

PROCEDURE FOR BASIC CLIMATIC AND DURABILITY TESTS FOR OPTICAL INSTRUMENTS

PART 12 SHOCK TEST

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Indian Standard
PROCEDURE FOR BASIC CLIMATIC AND DURABILITY TESTS FOR OPTICAL INSTRUMENTS
PART 12 SHOCK TEST

0. FOREWORD

0.1 This Indian Standard (Part 12) was adopted by the Indian Standards Institution on 31 May 1985, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Fast development in the field of instruments had brought a significant change in their basic content and design. It has been felt over the years that IS : 2352 - 1963* does not cater for the present day needs of the instruments and is also not in line with the recent trends in climatic and environmental testing procedures to be adopted for improving their quality and reliability. It has, therefore, become necessary to have uniform and more rational testing procedures as far as possible. This series of standards on climatic and durability test (IS : 10236) has been prepared with this objective.

0.2.1 It is proposed to withdraw the existing Indian Standard (IS : 2352-1963*) as soon as the tests mentioned therein are covered in the new series (IS : 10236).

1. SCOPE

1.1 This standard (Part 12) covers the procedure for conducting shock test for optical instruments.

2. TERMINOLOGY

2.0 For the purpose of this standard the following definition in addition to those given in IS : 10236 (Part 1)† shall apply.

---

*Procedure for basic climatic and durability tests for optical instruments.

†Procedure for basic climatic and durability tests for optical instruments : Part 1 General (*under preparation*).

2.1 Shock — Shock is an instantaneous excitation of a system which is characterized by suddenness, short duration and severity and usually causes significant relative displacement in the system.

3. OBJECT

3.1 The object of this test is to determine the structural robustness and suitability of optical instruments to withstand sudden non-repetitive mechanical shocks such as may be experienced during transportation and in weapons applications.

4. INITIAL MEASUREMENTS

4.1 The instrument shall be visually examined and checked optically, electrically and mechanically as required by the relevant instrument specification.

5. SHOCK MACHINE

5.1 The shock machine used for this test shall have the characteristics specified in **5.1.1** to **5.1.7**.

NOTE — In certain cases, for instance with the highly reactive loads the relevant instrument specification may allow tolerances less severe than those specified below.

5.1.1 The machine shall have a table or platform on which the instrument shall be mounted using its fixtures. Applied shocks shall be measured at the monitoring point, in this condition.

5.1.2 *Monitoring* — The shock shall be monitored by an accelerometer rigidly attached to the table or fixture used, at a point nearest to one of the specimen fixing points. For this purpose that specimen fixing point shall be chosen which is also nearest to the centre of the table surface unless there is a specimen fixing point having a more rigid connection to the table or fixture, in which case this shall be chosen.

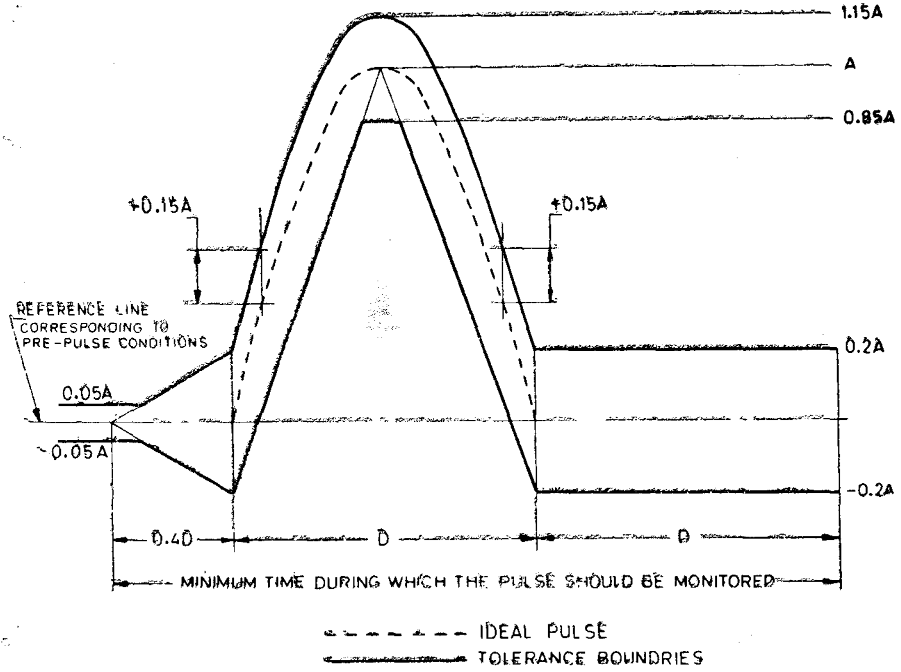
5.1.3 *Basic Pulse Shape* — The shock test machine shall be capable of generating at the table a pulse approximating to one of the ideal acceleration *versus* time curves given below:

a) Half sine curve which is one half cycle of a sine wave as shown by the dotted line in Fig. 1.

b) Final peak saw tooth curve which is an asymmetrical triangle with shortfall time as shown by the dotted line in Fig. 2.

The true value of the actual pulse shall be within the limit of tolerance as shown by the solid lines in Fig. 1 and 2.

5.1.4 *Accuracy* — The accuracy of the measuring system shall be such that it can be determined that the true value is within the given tolerances.

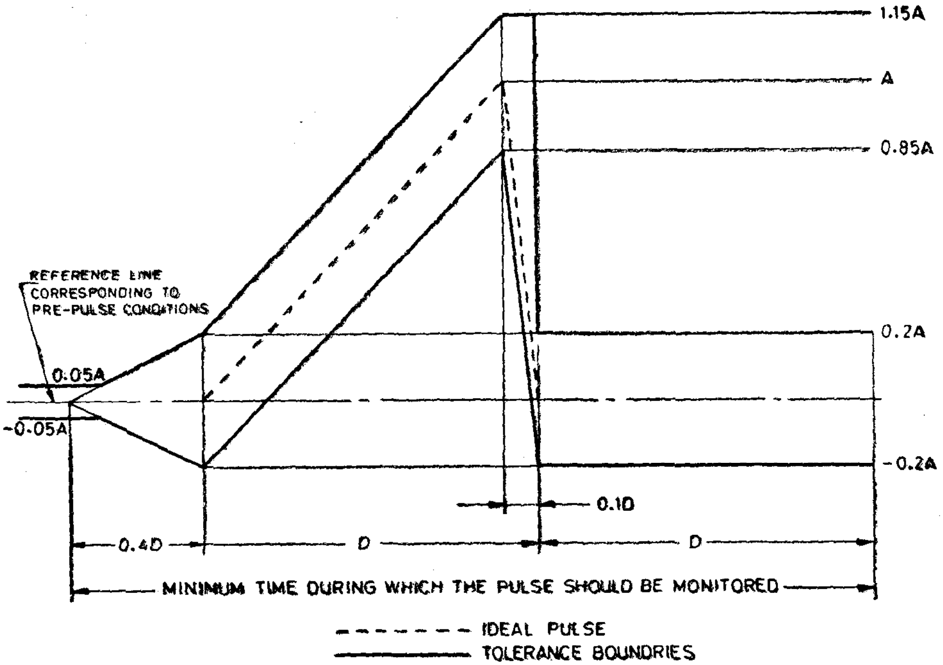

1.15A
A
0.85A
+0.15A
+0.15A
REFERENCE LINE CORRESPONDING TO PRE-PULSE CONDITIONS
0.05A
-0.05A
0.2A
-0.2A
0.4D
D
D
MINIMUM TIME DURING WHICH THE PULSE SHOULD BE MONITORED
IDEAL PULSE
TOLERANCE BOUNDRIES

D = duration of ideal pulse.

A = peak acceleration of ideal pulse.

The reference line shall not differ more than ±0·05*A* or ±9·8 m/s^2 (±1g), whichever is greater, from zero acceleration.

FIG. 1 HALF-SINE PULSE


1.15A
A
0.85A
REFERENCE LINE CORRESPONDING TO PRE-PULSE CONDITIONS
0.2A
0.05A
-0.05A
-0.2A
0.1D
0.4D
D
D
MINIMUM TIME DURING WHICH THE PULSE SHOULD BE MONITORED
IDEAL PULSE
TOLERANCE BOUNDRIES

D = duration of ideal pulse.

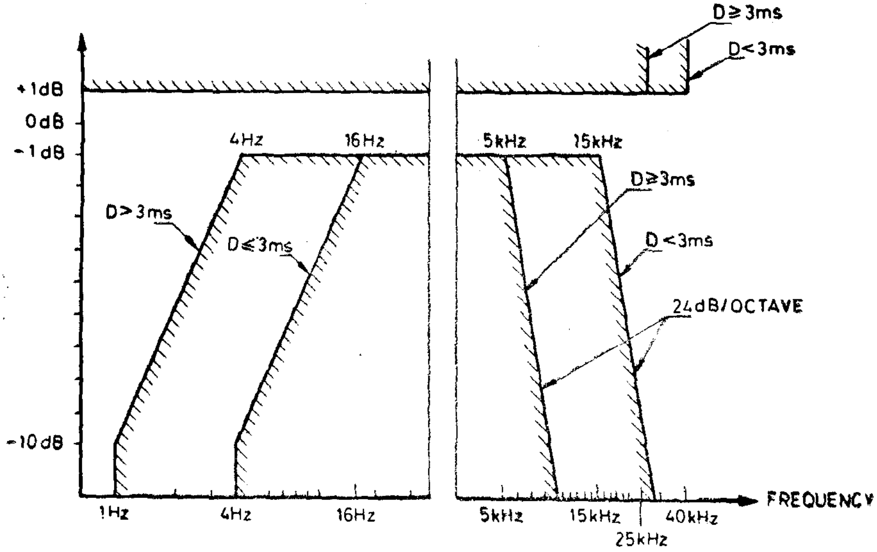
A = peak acceleration of ideal pulse.

The reference line shall not differ more than ±0·05*A* or ±9·8 m/s² (±1g), whichever is greater, from zero acceleration.

FIG. 2 FINAL PEAK SAW TOOTH PULSE

5.1.5 *Frequency Characteristics* — The frequency response of the overall measuring system including the acceleration shall be within the limits shown in Fig. 3.

NOTE — If it becomes necessary to employ filters to reduce the effect of any high frequency resonances inherent in the accelerometer it may be necessary to examine the phase characteristics of the measuring system in order to verify that the pulse shape is maintained.



Duration of Pulse (ms)	Low-Frequency (Hz) — 1 dB	Cut-Off — 10 dB	High Frequency Cut-Off (kHz) — 1 dB	Frequency Beyond Which the Response May Rise Above + 1 dB (kHz)
< 3	16	4	15	40
3	16	4	5	25
3 < *D* ≤ 18	4	1	5	25

FIG. 3 FREQUENCY RESPONSE OF MEASURING SYSTEM

5.1.6 *Velocity Change Tolerance* — For all pulse shapes, the actual velocity change shall be within ±10 percent of the value corresponding to the ideal pulse. To determine the velocity change, the actual pulse shall be integrated from 0·4 *D* before the pulse to 0·1 *D* beyond the pulse, where *D* is the duration of the ideal pulse.

5.1.7 *Transverse Motion* — The positive or negative peak acceleration at the monitoring point, perpendicular to the intended shock direction, shall not exceed at any time 30 percent of the peak acceleration of the ideal pulse in the intended direction, when determined with the measuring system.

6. TEST SEVERITY

6.1 One shock severity from the table given below shall be chosen. For the selected pulse shape, the shock severity shall be defined by a combination of the peak acceleration and the duration of the ideal pulse.

Severity	*Half Sine*	
	Peak Acceleration (*A*) *g* (Equivalent m/s²)	Corresponding Duration of the Pulse (*D*) ms
A1	15 (147)	11
B1	30 (294)	11
C1	30 (294)	18
D1	40 (392)	18
E1	50 (490)	11
F1	75 (736)	6
G1	75 (736)	11
H1	100 (981)	6
I1	500 (4 900)	1
J1	1 000 (9 810)	0·5
K1	1 500 (14 700)	0·5
L1	3 000 (29 400)	0·2

Severity	*Final-Peak Saw-Tooth*	
	Peak Acceleration (*A*) *g* (Equivalent m/s²)	Corresponding Duration of the Pulse (*D*) ms
A2	20 (196)	11
B2	30 (294)	11
C2	40 (392)	11
D2	40 (392)	18
E2	50 (490)	11
F2	75 (736)	11
G2	100 (981)	6

7. TEST PROCEDURE

7.1 The test is primarily intended for unpacked specimens. However, the items may be tested in their transport cases when such cases are considered as part of specimen itself. The mode of the testing shall be specified in the relevant instrument specification.

7.2 Whether the specimen has to operate during shock or merely to survive conditions of shock shall be clearly stated in the relevant instrument specification. In either case, the relevant specification should always prescribe the acceptable tolerance on performance which allows specimen to be considered satisfactory.

7.3 Mounting — Instrument in its unpacked condition or in its transport case if so specified shall be fastened to the shock machine either directly or by means of a fixture. Mounting fixture shall be such as to enable the specimen to be subjected to shock along the various axes as specified for conditioning. External connections necessary for measuring purposes shall add minimum restraint and mass.

7.3.1 The instrument shall be fastened to the shock machine by its normal means of attachment or as prescribed in the relevant instrument specification.

7.3.2 Instrument intended for use with isolators shall normally be tested with its isolators. If it is impracticable to carryout the shock test using the correct isolators, for example, when the instrument is mounted with other equipment in a common mounting system, the relevant instrument specification may permit shock test on the instrument using isolators specified for this case.

7.3.3 Any additional stays or straps shall be avoided. If cables or other items are required to be connected to the instrument during the test, these shall be arranged so as to add similar restraint and mass as in the normal installation.

7.3.4 Relevant instrument specification shall state whether the effect of gravitational force is important. In this case the instrument shall be so mounted that the gravitational force acts in the same direction as it would in use. Where the effect of gravitational force is not important, the instrument may be mounted in any attitude.

7.4 Conditioning

7.4.1 Unless otherwise specified three successive shocks shall be applied to the specimen in each direction of three mutually perpendicular axes so chosen that faults are most likely to be revealed (that is, a total number of 18 shocks). The pulse shape, amplitude and duration of the shock shall be specified in the relevant instrument specification.

NOTE — In case of instruments where shocks cannot be applied in one or two perpendicular axes because of gravitational force or some other considerations, six shocks relevant to each such axis shall not be applied.

7.4.2 If required the relevant instrument specification shall state whether the instrument shall be operated during the conditioning and if functional checks are required at any stage.

NOTE — Normally no functional checks need to be carried out between shocks.

7.4.3 After the shocks the instrument shall be removed from the table of the shock test machine.

8. FINAL MEASUREMENT

8.1 The instrument shall be visually examined for any signs of mechanical damage or looseness of parts. Its performance shall also be checked in accordance with the relevant instrument specification. The sealed instruments shall also be checked for leaks.

9. DETAILS TO BE GIVEN IN RELEVANT INSTRUMENT SPECIFICATION

9.1 The relevant instrument specification shall state the following for carrying out this test:

a) Initial observations/measurements;
b) Test severity;
c) Mode of testing (that is, unpacked or in its transport case);
d) Whether the instrument has to operate during shocks or merely to survive conditions of shocks (acceptable tolerance on performance to be prescribed);
e) Details of mounting and isolators (those which are relevant);
f) The directions during conditioning;
g) Operational and functional checks, if any;
h) Final observations/measurements; and
j) Any deviation from the normal procedure.